

DEVICE FOR REVOLVING LIQUIDS AND SUPPLYING GAS THERETO

The present invention relates to devices for supplying gas to liquids, such as aqueous liquids, and revolving the liquids. More particularly, the invention relates to such devices of the type commonly used for biological purification and which include a hollow shaft for supplying gas to the liquid and a propeller carried by the free end of the shaft, which is immersed in the liquid.

Devices of this type are known in the art, as through Austrian patent No. 276,262. The device there disclosed is of practical interest especially for aerating waste waters containing organic substances. However, such devices are also useful for other purposes, as for precipitating divalent iron from water by oxidation to three-valent iron or for removing carbonic acid from steam boiler water by aerating.

In biological purification of waste waters which contain organic solids, sediments are often formed which are so firm that anaerobic zones occur within them, what leads to formation of foul-smelling substances. In prior aerating devices, a great amount of energy is consumed for revolving the liquid so as to prevent formation of zones of stagnant liquid and sedimentation, as compared with the quantity of energy necessary for mixing air or oxygen with the liquid.

According to the present invention, it is now possible to effect the necessary mixing in of gas and revolving of the liquid with the use of an appreciably reduced amount of energy. Because the device produces a liquid jet which is kept well together and directed axially, it is possible by suitable adjustment of the shaft in the liquid container to avoid undesired sedimentation and formation of zones of stagnant liquid.

According to the invention, the new device is characterized in that the propeller consists of at least one screw-shaped vane, at least a part of the surface of which forms an acute angle with the longitudinal axis of the hollow shaft, as seen from the free end of the shaft, and which vane extends along at least two thirds of the circumference of the hollow shaft. A preferred embodiment is characterized in that the vane is arched in the direction towards the free end of the hollow shaft. Due to the length of the vane and the inclination of the vane surface, the liquid flow produced by the vane when the shaft rotates, and which moves between adjacent vane surface parts, is provided with a screw movement which sucks air from the hollow space of the shaft and mixes it well with the liquid.

Through the use of at least two vanes, preferably three, uniformly distributed around the circumference of the shaft, there are provided a plurality of outlet openings for the liquid from the propeller and thereby an improved dynamic balance of the device. This gives a smooth running of the shaft and consequently low loads on the bearings.

According to an additional feature of the invention, the pitch of the vane can decrease in the axial direction towards the free end of the hollow shaft. In this way, a desired acceleration of the liquid movement is obtained owing to the decreasing cross-section of the interspace between adjacent vane surfaces.

Since the liquid jet produced by the propeller is directed axially, this jet can be directed towards such places where dead zones or sediment formations easily can occur. To this end the hollow shaft can be carried by a cardan joint.

Sticking of solids to the inlet edge of the vane for the liquid can be avoided by increasing the radius of the vane towards the free end of the hollow shaft from zero. Through this circumstance, the solids only slide past the vane.

The liquid velocity of the jet can also be increased, so that the air can be sucked better with the liquid, if the opening of the free end of the hollow shaft widens as a funnel.

In order to prevent solids from sticking to the free end of the hollow shaft, a vane surface at this shaft end is joined at its outer edge to an adjacent vane surface in such a manner that a rounded, concave surface is formed, which is situated on the side facing away from the hollow space of the shaft. Through an arrangement of this concave surface at a distance radially outside the outside of the shaft, the velocity of the axial liquid jet is accelerated.

An additional feature of the invention is characterized in that the free end of the hollow shaft extends a distance past the end of the vane. The liquid jet leaving the vane end has the form of an oscillation with bulges and nodes; and when the position of the outlet opening of the hollow shaft is adjusted in such a manner that said opening is situated at the greatest diameter of the jet bulge, the depression and consequently the quantity of air sucked with the liquid are increased.

The depression and consequently the quantity of air sucked with the liquid are also increased if the vane extends a distance past the free end of the hollow shaft like a fin.

A further feature of the invention is characterized in that the wall of the hollow shaft has at least one opening, which is situated between adjacent vane surfaces, and that a covering sheet extends above said opening mainly tangentially in the flow direction of the liquid from the outside of the hollow shaft. At the end of a covering sheet, a liquid flow moving between adjacent vane surfaces will then jump from a greater radius back to the radius of the hollow shaft, a depression being formed which sucks air from the hollow shaft.

Above the liquid level, radially directed but helically shaped arms can be fixed to the hollow shaft. These arms serve to beat asunder the formed foam, and their helical shape prevents sticking of solids to said arms when the hollow shaft rotates in the operating direction, for the solids then slide off the arms.

If the arms are inclined in cross section in such a way that they act as fan vanes, they can suck foam from the foam layer and beat it asunder during operation of the hollow shaft.

The invention is described more in detail below with reference to the accompanying drawings, in which

FIG. 1 is an elevational view, partly in section, of an example of the present invention;

FIG. 2 is an end view of the propeller shown in FIG. 1, viewed toward the free end of the hollow shaft;

FIGS. 3 through 7 are longitudinal sectional views of five different embodiments of the propeller fixed to the hollow shaft and with differently shaped vanes of which the pitch decreases in the axial direction toward the free end of the hollow shaft;

FIG. 8 is a side view of a propeller and hollow shaft with openings in the wall of the latter;

FIG. 9 is a sectional view along line IX—IX in FIG. 8; FIG. 10 is an end view of a modification of the propeller;